Managing Late Blight in Tomato and Potato – An Essential Part of Gardening

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It is important to recognize that late blight is not like other diseases. It can’t be lived with because of its potential impact. It is arguably one of the most destructive diseases. Without control measures, total loss of tomatoes and potatoes usually occurs. Its occurrence in your garden can affect other gardens and farms due to the wind-dispersed spores.

Unfortunately, late blight has been occurring every year throughout the northeastern US since 2009, starting to develop during May to June. It used to be a rare disease that occurred sporadically and primarily in commercial potato crops. The pathogen has changed. New strains are more aggressive on tomato and tolerate warmer temperatures, thus they can continue to develop during summer.

Some of the first occurrences since 2009 have been in gardens, thus gardeners have become part of the management team with farmers.

Late blight epidemics can be stopped with prompt action. An outbreak in a LI community garden in June 2010 did not spread. The gardeners who saw what they thought might be late blight, promptly submitted samples to the CCE Diagnostic clinic, and then, following confirmation, promptly removed and bagged all the tomatoes and potatoes. Late blight can be confirmed by plant diagnosticians within minutes by examining tissue under a microscope or with a diagnostic test kit.

Information about the pathogen and disease:

Typically potato is the main crop affected because infested potato tubers currently are the main source of initial inoculum. Also, the strain (genotype) that has been occurring on potato is not very aggressive on tomato. Other potential sources are infected tomato transplants and infected crops in frost-free areas that produce spores wind-dispersed to crops in other areas. Infected petunia plants were a source one year. Late blight has been occurring most years in Florida since at least 1993. Affected tomatoes have been surviving cold periods in southern Florida, thus late blight can continue to develop into spring in Florida each year. Since 2005, late blight has continued developing into May in Florida, which is several weeks later than in the past. This suggests a strain has developed able to tolerate warmer temperatures, and it means this potential source of inoculum persists until crops are being produced north of Florida. Tomato and potato are grown throughout most of the eastern U.S. forming a potential ‘green bridge’ for the late blight pathogen (Phytophthora infestans) to progress through. Tomatillo is also a host; pepper and eggplant are not.

Pathogen strains vary in their aggressiveness on their host plants. They arise through chance mutation or recombination during sexual reproduction. The new strains present since 2009 are more aggressive on tomato than on potato, thus tomato plants were often severely affected while near-by potatoes had much less late blight. Those strains are not considered as aggressive as some strains that have occurred on tomato in the past! The ‘usual’ potato strain (US-8), which is very aggressive on this crop, has continued to occur mostly on potato recently.

Currently the late blight pathogen is only known to be able to survive on living host plant tissue (which includes tubers) in the US. It is an obligate pathogen unlike the early blight pathogen that can survive between crops on infested debris. This is because usually only one mating type of the pathogen exists in an area. Mating types are the fungal equivalent of males and females. When just one mating type is present, the pathogen can only reproduce asexually, which yields wind-dispersed spores (sporangia containing zoospores) that are in the fuzzy fungal growth that is common on affected tissue. When both mating types infect the same plant tissue and grow together, they can reproduce sexually and produce oospores, which have a thick wall enabling them to survive in soil overwinter in the absence of host tissue. Both the A1 and A2 mating types have been found in the USA, but rarely in proximity and oospores have not been found yet. Both mating types have been present and oospores produced in some areas of Europe (including Poland and Scandinavian countries) for at least the past decade. Consequently late blight occurs more regularly and rotation is now needed to manage this disease. The second mating type may have been transported to Europe in potatoes from Mexico in 1976.
Late blight can destroy a crop if unmanaged. The pathogen is well named: ‘Phytophthora’ in Latin means ‘plant destroyer’. Affected foliage tissue is quickly killed. Impact is especially great when stems are infected because all tissue above this point will die. Additionally tomato fruit at any stage are susceptible. Potato tubers can become infected when spores on stems are washed into the ground. This disease can be explosive especially under favorable conditions because the pathogen can produce a lot of wind-dispersed spores and it can cycle very quickly, progressing from infection to new lesion (spot) producing spores in 6 to 7 days. While cool, rainy conditions are especially favorable, late blight can develop in the absence of rain when relative humidity is at least 90%. And strains tolerating warmer temperatures have been occurring recently primarily on tomato enabling late blight to develop during the summer.

Many images of symptoms are available on the internet to assist with identification. Mine are posted along with additional information at:

http://www.hort.cornell.edu/lateblight

**Steps for managing late blight in the garden:**

1. Select varieties with resistance.
   
   **Tomato:** Defiant PhR (red slicer), Iron Lady (red slicer), Jasper (cherry), Mountain Magic (campari) and Plum Regal are the first varieties released with resistance to the main pathogen strains present since 2009. They were developed for the Northeast. More are in development. Iron Lady has resistance to early blight and Septoria leaf spot. These varieties are all being bred to contain known major genes for resistance to late blight (Ph2 and/or Ph3). While not bred to be resistant, Matt’s Wild Cherry is thought to contain a major resistance gene. It is important to understand that major resistance genes have the greatest suppressive effect but usually have activity for specific strains, and this pathogen has potential to evolve new strains able to overcome these genes. Resistant varieties, therefore, should not be the only management practice used. There is more information about tomato varieties and late blight in a downloadable pdf file posted under ‘Tomato’ at

   http://vegetablemdonline.ppath.cornell.edu/NewsArticles/NewsList.htm

   **Potato:** There are no varieties with a high level of resistance. Those described as having some resistance include Elba, Kennebec, Allegany, Sebago, Rosa, Defender, Jacqueline Lee, Desiree, and Ozette. Elba is considered the most resistant. Late blight in 2009 appeared to be less severe on some other varieties, notably Island Sunshine.

2. Select tomato transplants and potato seed with low chance of being infected (‘disease-free’).
   
   **Tomato:** Grow your own transplants if you have a greenhouse or purchase transplants produced under a late blight management program where late blight is not developing on plants inside or near the greenhouse. Some strains of the late blight pathogen can infect petunia and some solanaceous weeds. Inspect transplants carefully before purchasing to ensure none have late blight symptoms. The pathogen cannot survive on tomato seed.

   **Potato:** Plant only potatoes (tubers) being sold as ‘seed’. Do not use potatoes from your garden, even if you don’t think you had late blight. And do not use potatoes from a grocery store: there is higher tolerance for disease in ‘table stock’. Use certified seed potatoes (which means the producer’s crop was inspected and met state requirements that include set tolerances for key diseases). There is no guarantee that they are pathogen-free, therefore inspect tubers carefully before planting and also the plants as they develop. Infected tubers used as seed or not destroyed from the previous crop are considered the primary source of initial inoculum for late blight in the Northeast. For more information see:

   http://www.longislandhort.cornell.edu/vegpath/articles/roulette.html

3. Control volunteer tomato and potato plants as well as solanaceous weeds, in particular hairy nightshade and bittersweet nightshade. It is important to destroy any volunteer potato plants as soon as they sprout, rather than waiting until symptoms are seen because by then new spores likely will have already developed and spread to other gardens or farmers’ fields. Other weeds and ornamental plants that are also susceptible to some pathogen strains include jimson weeds, golden henbane, climbing nightshade, devil’s trumpet, Sodom apple, potato vine, apple of Peru, porcupine tomato, mandrake, tree tobacco, petunia, and calibrachoa. The late blight pathogen
cannot survive over winter on these plants, even perennial species, because the pathogen only infects leaves and other tissue killed by cold temperatures, these plants don’t produce tubers like potato; but these other host plants do serve as a place where the pathogen, once in an area, can multiple unsuppressed when they are not located in a fungicide-treated crop.

4. At least once a week, carefully inspect tomato, potato and tomatillo for symptoms of late blight. Most extension offices provide diagnostic services.

5. Check the web each week for information about late blight occurrence. See http://usablight.org/. Sign up to receive alerts when late blight is reported near-by. Note that during cloudy conditions spores of the late blight pathogen can survive being dispersed in wind currents long distances (miles!) because they are protected from the killing effects of UV radiation. Rain can bring these spores down on to plants far from the affected plants that were their source.

6. Monitor the late blight forecast model at http://uspest.org/risk/tom_pot_map. This provides forecasts of when conditions have been and likely will be favorable for specific locations, but does not consider presence of inoculum, which is usually the limiting factor and thus the deciding factor for outbreaks.

7. When there is a risk of late blight occurring and fungicide applications are going to be used as a component of management, apply them on a regular preventive schedule. Late blight is difficult to control, and can be impossible when fungicides are not applied before disease onset. Thorough spray coverage is critical.

Read the label of the fungicide, or the label of any other pesticide you are considering using, before purchasing the product. The specific directions on fungicide labels must be adhered to. Electronic versions of labels are available on the web. Labels for some products formulated for homeowner use are available at the Bonide web site. Make sure the plant to be treated plus the disease or insect pest are listed on the label. Fungicides can be toxic to some plants and they are not effective for all diseases. It is important to know the precautions for a product in advance so that you can obtain any necessary protective gear. There can be potential hazards to humans from exposure to a pesticide while applying it. Some are harmful if swallowed, absorbed through skin, inhaled, or get in eyes. Labels contain information on what "Personal Protective Equipment" is needed for the person handling the pesticide and first aid if exposure occurs. For example, anyone using chlorothalonil fungicide must wear: 1) A NIOSH approved respirator with an organic vapor cartridge or canister plus prefilter. (note that this is not a dust mask), 2) Waterproof gloves, 3) Protective eye wear, 4) Shoes plus socks, and 5) Long-sleeved shirt and long pants.

Most effective fungicides are those containing chlorothalonil (includes Fung-onil and Daconil). Fungicides approved for organically-produced plants that are available for gardeners include some formulations of copper, Actinovate, Serenade, and Regalia. A recommended organic fungicide program is copper alone or used in combination with the other biologically-based products.

8. If suspected symptoms of late blight are found, take a sample in a plastic bag to the local extension office for confirmation as soon as possible. If it is confirmed:

a. Immediately remove affected plant tissue. It is best to do this in the middle of a sunny day after the leaves have dried when there will be fewer spores and those dislodged in the process will likely be exposed to UV radiation. But don’t wait more than a day or two for these conditions. Put affected tissue in garbage bags, dig a hole and bury it, or put it in a pile and cover with a tarp. Heat that develops from sunlight hitting the tarp will quicken death of plant tissue and the pathogen. For the same reason, leave garbage bags in sun for a few days before throwing out. Affected plants can be buried in the ground or inside a compost pile; do not leave them on top of a compost pile as spores will continue to form until the plant tissue dies. Pathogen spores can survive up to a month when in a shady area, such as on a compost pile under trees.

It may be possible to save plants affected by late blight. Success depends on how early in disease development symptoms are found, how many infections are present that have not yet resulted in symptoms (spore germination to symptom takes about 7 days), how quickly and thoroughly diseased tissue will be removed, environmental conditions, proximity to other gardens or farms where late blight is developing, and what management steps will be taken.
b. Promptly inform neighbors growing susceptible crops so that they can be informed and take action to protect their plants. Due to the potential for spores to move from your plants to others, which could be destroyed if not protected, late blight needs to be treated as a ‘community disease’ for which communication is an important management tool.

c. Inspect plants daily thereafter for a week in order to find any additional affected tissue that develop symptoms, then return to inspecting at least once a week.

9. Apply fungicides frequently (typically weekly) as indicated on the label until the last tomatoes are picked or potatoes are dug. It is rarely possible to control late blight by solely relying on removing affected tissue. Even when rain is not occurring, high humidity and dew over night can provide a sufficient moisture period for infection. Especially when conditions are very favorable, it may not be possible to control late blight even with fungicides due to how quickly and destructively the disease can develop. Monitor disease development and be prepared to destroy foliage if late blight isn’t controlled (see step 11). See step 7 for more about fungicides.

Aggressive management will minimize the opportunity for both mating types if present in an area to infect the same plant tissue (chance event for spores to land on same plant), grow together, and produce oospores through sexual reproduction.

10. Tomato: Any fruit that rot after picking should be put in the trash or buried in a compost pile since there is a possibility that the pathogen could produce spores before the fruit completely rot. Unaffected parts of fruit can be consumed, but fruit from affected plants should not be canned due to concern that the pH may not be sufficiently low because of infection.

11. When late blight cannot be suppressed, plants should be promptly destroyed to eliminate the planting being a source of spores for other tomato or potato plantings in nearby gardens and farms. The pathogen typically is moved by wind up to 30 miles. This is an obligate pathogen that needs living host tissue to survive. Disturb foliage as little as possible to minimize the amount of spores dislodged. It is best to do this work in the middle of a sunny, preferably calm day after any moisture on leaves has dried to minimize the quantity of spores and also their likelihood of survival in the process. Bag affected tissue or bury in the ground or in a compost pile. Bags with affected plants should be left for a few days where they will be exposed to sun so that the plant tissue is killed before the bags go to the trash. Do not just leave plants on the ground or on top of a compost pile where spores will continue to be produced until the plant tissue dies. Other options where there are a lot of affected plants include putting them in a pile then covering them with a tarp until heat from the sun kills the plants or using a propane flamer for weeds.

Tomato: To initiate plant death with trellised tomatoes, go through the planting and cut all main stems at the base, then come back through and cut stems further up in the canopy plus trellising line to enable plant removal. It is best to do this work in the middle of a sunny, preferably calm day. Bag, bury, or tarp removed plants as described in 8 above.

The late blight pathogen cannot survive on stakes, therefore it is not necessary to throw out or even disinfect the stakes to manage this disease. Stakes should be disinfected however, especially if bacterial diseases also developed in the planting.

Potato: If tubers are present, plants could be cut at the base and the tubers left for about two weeks to provide an adequate time for pathogen spores to die and to allow the skin of the tubers to mature. Otherwise plants could just be pulled up and disposed of. Dig potatoes when soil is not too wet or cool (above 54F). Avoid bruising them. Tubers from plants that had late blight should be consumed as soon as possible. Check them for symptoms before consuming. Tubers not eaten immediately should be kept in a cool, dry place where there is air movement if possible.

12. The late blight pathogen is not able to survive overwinter in plant debris unless the pathogen produces oospores, which it is not known to do in the USA yet, therefore rotation is not presently a necessary management practice for this disease, but it is needed for other diseases (e.g. Septoria leaf spot and early blight).